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ORIGINAL

RECORD OF DECISION

SELECTED REMEDIAL ACTION

State of Oregon
Department of Environmental Quality

Port of Portland Marine Terminal 1 South
Portland, Oregon
ECSI No. 2642

September 2002

Prepared by:

Oregon Department of Environmental Quality
Voluntary Cleanup and Portland Harbor Section

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1.0 INTRODUCTION

This document presents the Oregon Department of Environmental Quality's (DEQ's) selected remedial action for soil and groundwater contamination at the Port of Portland's (POP) Marine Terminal 1 South (T1S) facility, located at 2100 NW Front Avenue Portland, Oregon. This action was selected in accordance with Oregon Revised Statutes (ORS) 465.200 through 465.455, Oregon Administrative Rules (OAR) Chapter 340, Division 122, Sections 010 to 140.

The selected remedial action is based on the administrative record for this site. A copy of the administrative record index is presented in Attachment A. This document summarizes the more detailed information contained in the site characterization, risk assessment, and feasibility study reports. The investigation was performed under DEQ's oversight in the Voluntary Cleanup Program (VCP).

The selected remedial action addresses arsenic, lead, polynuclear aromatic hydrocarbon (PAH) and total petroleum hydrocarbon (TPH) contamination in soil and groundwater at the T1S facility. The selected action for the facility consists of the following elements:

- Removal of contaminated soil above risk-based soil cleanup levels. Soil between 0 and 3 feet below ground surface (bgs) above clean-up levels protective of future site residents will be removed. Soil between 3 and 15 feet bgs above levels protective of construction workers and trench workers will be removed. Excavated soil will either be disposed of at an off-site DEQ permitted landfill or treated by thermal desorption.

- Institutional controls including a deed restriction (e.g., DEQ-approved Easement and Equitable Servitude) to assure that future land use remains consistent with the selected remedy and a soil management plan be developed to prevent exposure to soil contamination remaining on-site following the removal of soil hot spots and soil above risk-based criteria.

2.0 SITE CHARACTERIZATION

This document summarizes the information contained in the *Terminal 1 South Remedial Investigation Report* (RI) - Volumes 1 and 2 (Hahn and Associates, 2001a), *Terminal 1 South Human Health and Ecological Baseline Risk Assessment* (Hart Crowser, 2002a) and *Risk Assessment Addendum* (Hart Crowser, 2002b) and *Terminal 1 South Feasibility Study Report* (FS; Hart Crowser, 2002c). The above-mentioned reports were submitted to DEQ for review and approval.

2.1 Site Description

The project site, T1S facility is located at 2100 NW Front Avenue in Portland, Oregon (Figure 1). The site consists of approximately 21 acres located northwest of Interstate 405 (Fremont Bridge), northeast of NW Front Avenue, southeast of Slip No. 2, and southwest of the Willamette River. A majority of the site is paved with asphalt or concrete or covered by buildings. Site features are

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shown on Figure 2. Two primary structures, designated as Warehouse No. 2 and House No. 104, are currently being demolished at the T1S facility. Tristar Transload leased and operated the open storage area between Slip No. 2 and House No. 104 and portions of House No. 104. The remaining portions of the site are unoccupied. Additionally, an extensive dock structure is present over submerged lands at Berths 104, 105, and 106. Historically, Terminal 1 has been used for staging of lumber, logs, paper products, steel containers, and bagged grain. The existing buildings are being demolished and the T1S facility is scheduled for redevelopment for residential and commercial purposes.

The T1S site is located immediately upstream of what is known as the Portland Harbor, a six-mile reach of the Willamette River between Sauvie Island and Swan Island. A 1997 study by DEQ and the U.S. Environmental Protection Agency identified elevated levels of hazardous substances in shallow, near-shore sediments throughout the Portland Harbor. A Remedial Investigation (RI) and Feasibility Study (FS) of the initial study area (ISA) of Portland Harbor sediments is currently being performed under EPA oversight by a group of potentially responsible parties.

2.2 Environmental Setting

The topography at the T1S facility is generally level at an elevation of approximately 30 feet above mean sea level (msl). The site is generally paved with asphalt or concrete with no vegetation and little bare ground present.

The T1S facility is underlain by sand and silt with occasional gravel to the maximum depth of investigation at 80 feet bgs (Hahn and Associates, 2001a). Based on historical documentation and investigations, the property has been extensively filled over time; fill material was encountered from the surface to depths of 32 to 67 feet bgs. Soil also thought to be former Willamette River sediments were encountered in boring B-84 at the former slip Number 1 site at a depth of approximately 67 bgs (Figure 2).

Groundwater in the vicinity of the T1S facility generally occurs in three principal hydrogeologic zones: (1) shallow unconfined fill/alluvial deposit (shallow water-bearing zone [WBZ]); (2) generally confined Troutdale WBZ; and (3) confined Columbia River Basalt WBZ (Hahn and Associates, 2001a). Unconfined groundwater was encountered within the shallow WBZ (fill) at an average depth of approximately 23 feet bgs. Groundwater beneath the facility is expected to flow to the northeast towards the Willamette River.

2.3 Current and Reasonably Likely Future Land Use

The current and reasonably likely future land use is well defined. The site is currently zoned as Central Residential (RX) such that it can be redeveloped for an alternative use. The RX zoning is considered the comprehensive plan for the property. Based on the RX zoning designation, it is expected the site will be used for mixed-use residential/commercial development in the future.

2.4 Current and Reasonably Likely Future Groundwater Use

A beneficial groundwater use evaluation was conducted for the Hoyt Street Property (RETEC, 1997) that adjoins the southeast corner of the T1S facility. Hahn and Associates conducted an additional well inventory as part of the RI and the groundwater monitoring study to supplement the RETEC survey. Based on trends in groundwater use in the area and RETEC fate and transport modeling, the only identified beneficial use for groundwater is surface water recharge of the Willamette River. No water wells were found to be in use within 0.5 mile of the T1S facility. No surface water rights were identified within 0.5 mile of the T1S facility.

3.0 SITE INVESTIGATION SUMMARY

In 1998, Maul Foster and Alongi, Inc. conducted a Focused Environmental Site Assessment (ESA) for a portion of Terminal 1 located between Slip Number 2 and the Fremont Bridge. The purpose of the ESA was to evaluate if significant releases of petroleum products or hazardous substances had occurred on the subject property. The ESA identified releases of petroleum products and hazardous substances at the facility.

In July 2001, Hahn and Associates completed an RI, under DEQ oversight, at the T1S facility (Hahn and Associates, 2001a). RI activities consisted of the following investigation phases:

- Environmental Baseline Investigation completed by Hahn and Associates in February and March 2000 (Hahn and Associates 2001a);
- B-38 Area Characterization completed by Hahn and Associates in March 2000 (Hahn and Associates 2001a);
- Supplemental Site Characterization Activities completed by Hahn and Associates in September 2000 (Hahn and Associates 2001a);
- Data Gap Investigation completed by Hahn and Associates during October and November 2000 (Hahn and Associates 2001a); and
- A total of 112 push-probe borings were installed for the collection of soil and groundwater samples during the ESA and RI site activities. Push-probe locations are shown on Figure 2.

Hahn and Associates (2001b) conducted a groundwater investigation at the T1S facility in August, September and October 2001. Site activities included installation, development, and sampling of seven groundwater monitoring wells at the site. The locations of the groundwater monitoring wells are presented on Figure 2.

4.0 NATURE AND EXTENT OF CONTAMINATION

Contaminants of interest (COI) are defined as contaminants detected at the site, and contaminants of potential concern (COPCs) are those COIs that exceed the appropriate risk-based screening levels for human health or ecological receptors. COPCs are discussed in Section 5. The COIs investigated during the site characterization activities included the following groups of contaminants:

- TPH as diesel and oil;
- PAHs;
- Volatile organic compounds (VOCs);
- Polychlorinated biphenyls (PCBs); and
- Metals.

The nature and extent of soil and groundwater contamination was defined during the site characterization activities described in Section 3 and presented in the RI report (Hahn and Associates, 2001a, 2001b, and 2002). The T1S site was subdivided into three areas of concern for the RI: parcels A, B, and C (Figure 2). These parcels are consistent with Tax Lot lines.

Soil contamination above cleanup levels was found on Parcels A and B. Contamination detected on Parcel C was evaluated and it was determined that the low level contamination did not pose an unacceptable risk to human health or the environment (See Section 5.1.3). A No Further Action (NFA) finding was issued for Parcel C in August 2002. Contamination at the facility is suspected to be from incidental releases and spills and a dry well.

4.1 <u>Soil</u>

4.1.1 TPH and PAHs

Based on the data collected at the T1S facility, seven general areas/locations of soil impacted with petroleum hydrocarbons (diesel- and oil-range) were identified and include the B-5, B-20, B-29, B-37 (dry well), B-38, B-84 (former Slip No. 1), and B-102 areas (Figure 2). In general, higher concentrations of petroleum hydrocarbons have been identified in the B-5, B-37 (Dry Well), B-38, and B-102 Areas (typically greater than 1,000 to 2,000 milligrams per kilogram [mg/kg]), while lower concentrations of petroleum hydrocarbons were detected in the B-20, B-29, and B-84 Areas (less than 300 mg/kg). Petroleum constituents including PAHs have been detected above potentially applicable risk-based screening levels (RBSLs) in three areas including the B-20, B-37 (dry well), B-38, and B-92 Areas. The greatest volumes of petroleum-impacted soil are in the B-37 and B-38 Areas. In addition, elevated arsenic and/or lead concentrations were detected at borings B-3 and B-11, and in the B-38 Area. Maps depicting the distribution of petroleum hydrocarbons, benzo(a)pyrene, and lead and arsenic in various areas of the Site are included on in the RI Report (see Figures 4 – 16 of the RI report, Hahn and Associates, 2001a).

Former Slip No. 1 (B-84) Area. One soil boring (B-84) was advanced to a depth of 80 feet bgs in a location within the former (now filled) Slip No. 1 (see Figure 3 of the RI Report). The interface between former Slip No. 1 river sediments and the overlying fill at boring B-84 is interpreted to be at a depth of approximately 67 feet bgs (see Table 2 of the RI Report). A soil sample was collected from 67 feet bgs to evaluate the quality of what are believed to be former slip sediments. Diesel- and oil-range petroleum hydrocarbons were detected in this soil sample at a combined concentration of 298 mg/kg (see Table 4 of the RI Report). PAH compounds were not detected in the soil sample; however the method detection limits for this sample were elevated above RBSLs for a number of PAHs (see Table 5 of the RI Report). Metals were either not detected or not detected at levels of concern in this same sample. PCBs were detected at a concentration (0.0831 mg/kg) well below the residential U.S. Environmental Protection Agency (EPA) Region 9 preliminary remedial goal (PRG) for of 0.22 mg/kg.

B-5 Area. Oil-range petroleum hydrocarbons were detected in soil at boring B-5 (0-2 feet bgs) at a concentration of 6,030 mg/kg (see Figure 5 and Table 4 of the RI Report). The shallow petroleum impacts in this area appear to be limited to the upper 2 to 3 feet of soil and were laterally defined by subsequent borings. PAH compounds, where detected, were below screening levels (see Table 5 of the RI Report). PCBs, VOCs, and metals were either not detected or were detected at levels below applicable RBSLs in this same sample.

B-20 Area. Diesel- and oil-range petroleum hydrocarbons were detected in soil in the B-20 Area at a maximum combined concentration of 233 mg/kg (B-57 at 1.0 feet bgs) (see Figure 6 and Table 4 of the RI Report). Five PAH compounds were detected in boring B-53 at concentrations exceeding screening levels (see Table 5 of the RI Report). PCBs, VOCs, and metals were either not detected or not detected at levels of concern in this same sample. The shallow petroleum impacts in this area appear to be limited to the upper 2 to 4 feet of soil. The detected concentrations of three PAH compounds in this area are above RBSLs. Although the lateral extent of the shallow PAH impacts in this area is not defined, the impacts are considered to constitute one of the smaller areas of soil exceeding RBSLs at the T1S facility based on available total petroleum hydrocarbon concentration data.

B-29 Area. Oil-range petroleum hydrocarbons were detected in soil in the B-29 Area at a maximum concentration of 112 mg/kg (B-59 at 4.0 feet bgs) (see Figure 7 and Table 4 of the RI Report). PAH compounds were detected, but at concentrations less than RBSLs (see Table 5 of the RI Report). PCBs, VOCs, and metals were either not detected or were detected at concentrations below RBSLs in this area. The shallow petroleum impacts in this area appear to be limited to the upper 5 to 7 feet of soil.

B-37 (Dry Well) Area. Diesel- and oil-range petroleum hydrocarbons were detected in soil in the B-37 (dry well) Area at a maximum combined concentration of 20,700 mg/kg (B-65 at 12.0 feet bgs) (see Figure 8 and Table 4 of the RI Report). PAH compounds were detected in 23 of 24 soil samples at total concentrations ranging from 0.5 mg/kg to 1,476 mg/kg (B-63 at 10.5 feet bgs) (see Table 5 of the RI Report). Five PAHs were found to exceed RBSLs, with benzo(a)pyrene exceeding the screening level of 0.062 mg/kg in 18 samples (see Figure 9 and Table 5 of the RI Report). PCBs, VOCs, and metals were either not detected or were detected at concentrations less than RBSLs in this area. The petroleum impact in this area was found to be present in soil at depths of ranging between 2 to 24 feet bgs and is considered to constitute one of the larger areas of impacted soil at the T1S facility.

B-38 Area. Diesel- and oil-range petroleum hydrocarbons were detected in soil in the B-38 Area at a maximum combined concentration of 34,000 mg/kg (B-38 at 10.0 feet bgs) (see Figure 11 and Table 4 of the RI Report). PAH compounds were detected in 30 of 53 soil samples at total concentrations ranging from 0.115 mg/kg to 156 mg/kg (B-68 at 2.5 feet bgs) (see Table 5 of the RI Report). Five PAHs were found to exceed RBSLs, with benzo(a)pyrene exceeding the RBSL of 0.062 mg/kg in 18 samples (see Figure 12 and Table 5 of the RI Report). Aromatic VOCs (e.g., benzene, toluene, ethylbenzene, and xylenes [BTEX]) and PCBs were not detected in this area. VOCs were either not detected or not detected at levels of concern in this area. Other than lead and arsenic (See Section 4.1.3), metals were not detected at levels of concern. The petroleum impacts in this area were found to be present in soil from the surface to depths of 27 feet bgs. The extent of benzo(a)pyrene in surface soil (0 to 3 feet bgs) is defined other than a small area to the west of boring B-68.

B-102 Area. Diesel and oil-range petroleum hydrocarbons were detected in boring B-102 at a maximum combined concentration of 2,930 mg/kg at a depth of 10 feet bgs (see Figure 11 of the RI Report). Two PAHs (anthracene and pyrene) were detected, however the concentrations are below RBSLs. Boring B-102 is located across NW Front Avenue and west of B-97 where petroleum impacts were not detected at 10 feet bgs suggesting that petroleum hydrocarbons detected in soil at B-102 are unrelated to the T1S facility and the B-38 Area.

4.1.2 Volatile Organic Compounds (VOCs)

BTEX and VOC compounds were not detected in any of the soil samples analyzed, with the exception of two VOCs. Acetone and 2-butanone were detected in one sample from boring B-80 (10 feet bgs in the B-38 Area) at concentrations of 0.22 mg/kg and 0.0346 mg/kg, respectively. The detected acetone and 2-butanone concentrations are well below the residential EPA Region 9 PRGs for these compounds at 1,600 mg/kg and 7,300 mg/kg, respectively. The source of the acetone and 2-butanone compounds at B-80 is not known, but may be attributable to laboratory contamination. BTEX compounds and other VOCs are not COPCs at the T1S facility.

4.1.3 Polychlorinated Biphenyls (PCBs)

PCBs were detected in one sample from boring B-84 (former Slip No. 1) at a concentration of 0.0831 mg/kg. This sample was collected from a depth of 67 feet bgs, a depth where former Slip No. 1 sediments (pre-approximately 1972) were believed to have been encountered. The detected PCB concentration is well below the residential EPA Region 9 PRG of 0.22 mg/kg. PCBs are not COPCs at the T1S facility.

4.1.4 Metals

Concentrations of metals were detected in all soil samples collected at the T1S facility. However, only arsenic and lead were detected at concentrations that exceed RBSLs. Arsenic and lead were detected at concentrations ranging from 1.35 to 12.9 mg/kg and 2.73 to 6,190 mg/kg, respectively. All detected concentrations of arsenic exceed the residential RBSL of 0.39 mg/kg. Only two detected concentrations of lead in soil (807 and 6,190 mg/kg) in the B-38 Area exceed the residential RBSL of 400 mg/kg. The elevated concentrations of lead in soil appear to correspond to areas of elevated concentrations of petroleum hydrocarbons in soil, whereas arsenic concentrations do not appear to correlate with TPH concentrations.

Natural background concentrations of arsenic in the Portland area typically exceed the residential RBSL for arsenic of 0.39 mg/kg. Accordingly, an assessment of background arsenic levels was conducted utilizing available site data to determine a more appropriate screening level for arsenic. The results of the analysis indicate a background concentration for arsenic at the T1S facility of 5.3 mg/kg. This concentration is comparable to the 5.0 mg/kg value determined for arsenic at the nearby Hoyt Street Property.

Four soil samples in three areas of the T1S facility detected arsenic at concentrations that exceed the established background level of 5.3 mg/kg (see Table 6 of the RI Report). The elevated arsenic was detected at boring B-3 (11.8 mg/kg at 11 feet bgs), located in Area C (the southeast portion of the T1S facility), boring B-11 (11.2 mg/kg at 9 feet bgs), located in Area B (the northwest portion of the T1S facility), and at borings B-68 (12.9 mg/kg at 2.5 feet bgs) and B-97 (7.53 mg/kg at 2.5 feet bgs) located in Area A.

The highest lead (6,190 mg/kg) and arsenic (12.9 mg/kg) concentrations at the T1S facility were detected at boring B-68 (2.5 feet bgs) in the B-38 Area (see Figure 13 of the RI Report). The extent of arsenic and lead at concentrations above screening levels in the shallow soil at boring B-68 has been delineated.

4.2 <u>Groundwater</u>

4.2.1 Groundwater Grab Samples

Thirty (30) groundwater grab samples (see Figure 3c of the RI Report) were collected and analyzed during the RI at the T1S facility. The grab samples indicated PAHs and metals were the compounds most typically detected at concentrations above the PRGs for tap water or DEQ's Ecological Level II Screening Benchmark Values (EBSLs; see Table 7 and Figures 14 and 15 of the RI Report). VOCs, including BTEX compounds, were not detected in any of the groundwater samples analyzed. Other than DEHP, SVOCs were not detected in six baseline investigation groundwater samples. Of 13 dissolved (filtered) metals analyzed, arsenic, copper, and lead were detected in groundwater at concentrations above EPA drinking water PRGs and/or DEQ EBSLs.

4.2.2 Groundwater Monitoring Wells

Based on the results of the groundwater grab samples, seven groundwater monitoring wells were installed in August 2001 (Hahn and Associates, 2001b). Groundwater monitoring well locations are shown on Figure 2. These wells were sampled in September 2001 and January 2002. Selected samples were analyzed for TPH, PAHs, total and dissolved metals. A complete pathway for human exposure to contaminated groundwater was not identified. Groundwater recharge to surface water was identified as a beneficial water use, therefore, groundwater monitoring results were compared to EBSLs for surface water. The groundwater monitoring results are summarized below:

TPH. TPH analysis of groundwater samples was conducted in selected wells. Diesel-range TPH was detected at a maximum concentration of 416 micrograms per liter (µg/L) in MW-1.

PAHs. PAHs were present at low concentrations (less than 1.1 (µg/L) in five of the seven monitoring wells (Table 4 of the Groundwater Sampling Report). The detected PAHs, all non-carcinogenic, were present at concentrations below EBSLs.

Metals. Total (unfiltered) arsenic and chromium were detected in groundwater at concentrations below EBSLs at all well locations. Lead at MW-7 was detected at a concentration (4.47 µg/L) that exceeded the EBSL (2.5 µg/L) in both sampling rounds and copper exceeded (40.2 µg/L) the EBSL (9 µg/L) in one well in the first sampling round. Analysis of dissolved (filtered) arsenic, copper, chromium, and lead was conducted at all well locations. Most dissolved concentrations were reduced to below laboratory detection levels. Dissolved concentrations did not exceed applicable EBSLs in any well.

4.3 Locality of Facility

OAR 340-122-115 (34) defines "Locality of Facility" (LOF) as any point where a human or ecological receptor contacts, or is reasonably likely to come in contact with, facility-related hazardous substances. Chemicals have been detected in both soil and groundwater at various areas of the site, but off-site migration of contamination is not evident based on the existing data. Accordingly, the LOF is defined only as the T1S facility and the adjacent area on Front Avenue in Area A (Hart Crowser, 2002a).

5.0 RISK ASSESSMENT

After completing the site investigation, the data were used to evaluate potential risks to human health and the environment (Hart Crowser, 2002a).

5.1 Human Health Baseline Risk Assessment

Hart Crowser (2002a; 2002b) conducted a human health risk assessment (HHRA) for the T1S facility. The purpose of the HHRA was to evaluate potential risks and hazards to human health associated with each potential exposure pathway (complete pathways identified for the site are exposure to surface and subsurface soil). The site exposure conceptual site models (CSM) for human health and ecological receptors are shown in Figures 3 and 4, respectively.

5.1.1 COPC

COIs were screened in accordance with DEQ's *Guidance for Conduct of Deterministic Human Health Risk Assessments* (1998) to identify contaminants of potential concern COPC for the purposes of performing the human health risk assessment. COI were screened based on their frequency of detection and a comparison of maximum concentrations detected onsite with PRGs. The following COPCs were identified:

Area A	Area B	Area C
Soil: TPH benzo(a)anthracene benzo(a)pyrene benzo(b)fluoranthene dibenzo(a,h)anthracene indeno(1,2,3-cd)pyrene arsenic, lead	**Soil:** TPH benzo(a)anthracene benzo(a)pyrene benzo(b)fluoranthene dibenzo(a,h)anthracene indeno(1,2,3-cd)pyrene arsenic	**Soil:** arsenic
Groundwater: PAHs Tetrachloroethene (PCE) arsenic	**Groundwater:** PAHs arsenic	**Groundwater:** PAHs arsenic

5.1.2 Receptors

Based on a reasonably likely future land use of a mixed residential and commercial development, the HHRA evaluated the potential risk to the following populations that could be exposed to contamination present at the site:

- Future residents;
- Current and Future commercial workers;
- Current and Future utility/excavation workers; and
- Future construction workers.

The risk assessment assumed that residents' and commercial workers' exposure to contaminated soil was limited to soil between 0 and 3 feet bgs. Utility workers and construction workers were assumed to be exposed to contaminated soil between 0 and 15 feet bgs, based on the depth of planned utilities and subsurface parking for the proposed development. It was assumed that no complete exposure pathway to contaminated soil below 15 feet bgs exists under current or reasonably likely future land use scenarios.

5.1.3 Risk Characterization

Risks to human health were calculated for Parcels A, B and C. The results of the risk calculations are summarized in Tables 1 and 2. Soils exceeding acceptable risk based concentrations are shown on Figure 5. In addition, the potential for human health risks from the ingestion of recreationally caught fish was evaluated.

Groundwater is not currently used and is not reasonably likely to be used at the T1S facility. There is no documented potable use of groundwater within a 1-mile radius of the site and the City of Portland has supplied drinking water to the industrial district for decades. Therefore, human exposure to groundwater via ingestion or direct contact was not considered a complete pathway. However, as a conservative risk screening measure, hazardous substance concentrations detected in groundwater were evaluated to assess if groundwater discharging to the Willamette River poses a theoretical risk to human health from the human ingestion of fish exposed to contaminated groundwater.

5.1.3.1 Area A

The assessment of carcinogenic risks to residential receptors exposed to contaminated soil within Area A indicated that under both Reasonable Maximum Exposure (RME) and Central Tendency (CT) conditions, the potential risks exceeded DEQ acceptable risk levels. COPCs that exceeded DEQ's acceptable risk of 1×10^{-6} excess cancer risk (i.e., 1 in a million) for individual carcinogens are benzo(a)pyrene, benzo(a)anthracene, dibenzo(a,h)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene and arsenic. The assessment of noncarcinogenic risks identified only lead as present above acceptable risk levels (a hazard quotient [HQ] of 1) for residential exposure under both RME and CT conditions.

For the commercial worker exposure scenario, the estimated cumulative carcinogenic risks for exposure to contaminated soil were found to be acceptable under both RME and CT conditions. However, benzo(a)pyrene and arsenic exceeded the DEQ acceptable risk level for individual carcinogens. The assessment of noncarcinogenic risks identified lead as present above the acceptable risk level for commercial worker exposure under only the RME condition.

For the excavation and construction worker exposure scenario, no unacceptable risks from exposure to carcinogens were identified. The assessment of noncarcinogenic risks identified lead as present above the acceptable risk level for excavation and construction worker exposure under only the RME condition.

As discussed in the HHRA report, the RME and CT exposure point concentrations (EPCs) for lead in surface and total soil in Area A are driven by the maximum detection in one sample (B-68). Additionally, while arsenic was identified as a carcinogen resulting in unacceptable risks in Area A, there were only two soil samples (within the depth ranges evaluated in this HHRA) that exceeded the site specific background level of 5.3 mg/kg identified in the RI (Hahn and Associates, 2001a).

5.1.3.2 Area B

The assessment of carcinogenic risks to residential receptors exposed to contaminated soil within Area B indicated that potential risks exceeded DEQ acceptable risk level only under the RME condition. COPCs that exceed the DEQ acceptable risk level for individual carcinogens are benzo(a)pyrene and arsenic. The assessment of noncarcinogenic risks found no exceedences of DEQ acceptable risk levels for residential exposure.

For the commercial worker exposure scenario, the estimated cumulative carcinogenic risks for exposure to soil were found to be acceptable under both RME and CT conditions. However, arsenic exceeded the DEQ acceptable risk level for individual carcinogens under the RME condition. The assessment of noncarcinogenic risks found no exceedences of DEQ acceptable risk levels for commercial worker exposure.

No unacceptable carcinogenic or noncarcinogenic risks were estimated for the excavation or construction worker exposure in Area B.

Arsenic was identified as a carcinogen resulting in unacceptable risks in Area B for residential and commercial worker soil exposure scenarios. However, there were no detected concentrations of arsenic in soil in Area B that exceeded the site specific background level of 5.3 mg/kg identified in the RI (Hahn and Associates, 2001a).

5.1.3.3 Area C

The cumulative RME and CT carcinogenic risks for all potential receptors (resident, commercial worker, excavation and construction worker) exposed to contaminated soil within Area C were found to be acceptable with the exception of the RME residential scenario. Arsenic exceeded DEQ individual carcinogen acceptable risk level for the RME residential and commercial worker scenarios. The assessment of noncarcinogenic risks found no exceedences of DEQ acceptable risk levels for all potential receptors. There were no detected concentrations of arsenic in surface soil in Area C that exceeded the site specific background level of 5.3 mg/kg identified in the RI (Hahn and Associates, 2001a). Arsenic was detected at a maximum concentration of 11.8 mg/kg at a depth of 11 bgs.

Although the HHRA identified unacceptable risk in Area C, the risk is associated with arsenic concentrations that are below the site-specific background concentration in surface soil. Therefore, the risk in Area C is considered acceptable and no further action (NFA) is needed for Area C. DEQ issued a NFA determination letter for Area C in August 2002.

5.1.4 Potential Human Health Risk from Fish Consumption

The potential for human health impacts from groundwater discharge into the Willamette River and subsequent fish ingestion by recreational anglers was evaluated using available groundwater monitoring well data. Groundwater data were screened against existing surface water criteria

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developed for the protection of human health from the ingestion of fish tissue. The existing groundwater data from the two completed rounds of monitoring were screened against DEQ and EPA screening levels for this exposure pathway.

VOCs were either not detected or were detected at concentrations below DEQ's Surface Water Criteria for Fish Consumption (Table 20 – OAR 340-041) in all groundwater samples. Non-carcinogenic PAHs were either not detected or detected at concentrations below both DEQ's Surface Water Criteria for Fish Consumption (Table 20) and EPA's National Recommended AWQC for Fish Consumption in all groundwater samples. For carcinogenic PAHs, DEQ Table 20 does not provide criteria for individual PAHs but does provide a total PAH criteria of 0.0311 µg/L. This criterion was exceeded in five of the seven wells (maximum concentration 2.054 µg/L). The more recent EPA Recommended Freshwater AWQC for Fish Consumption, which was updated based on toxicity factors present in the EPA IRIS database in 1998, provides criteria for individual PAHs and is also based on a carcinogenic risk standard of 1×10^{-6}. This standard is equivalent to DEQ's definition of acceptable risk for individual carcinogens.

No carcinogenic PAHs were detected in any of the groundwater monitoring wells. However, the detection limits achieved for the groundwater samples were above the updated EPA AWQC for fish consumption. Generally, in risk assessments, a proxy concentration of one half the detection limit is often used to represent contaminant concentrations in situations where the contaminant has been detected in at least one sample. While such an analysis is considered conservative in this situation, as carcinogenic PAHs were not detected in any of the groundwater samples, the proxy concentration thus generated is generally 0.050 µg/L, essentially equal to the EPA AWQC of 0.049 µg/L. This increases the confidence that levels of carcinogenic PAHs are not present above levels of concern at this site. In addition, this comparison is conservative in that it assumes that fish are exposed to PAH concentrations in surface water at concentrations equal to the groundwater concentrations detected in upland monitoring wells over 50 feet from the river. This comparison does not consider chemical degradation, attenuation or dilution of concentrations as groundwater moves towards the river and discharges into the river.

The total and dissolved levels of arsenic found in the groundwater samples exceed both DEQ and EPA Recommended criteria for the protection of human health from the ingestion of fish tissue, as well as a regional Willamette River watershed background level of 2.0 µg/L. However, the detected concentrations may be representative of background concentrations in the shallow fill WBZ.

The conclusion of the human health fish consumption exposure scenario evaluation is that the concentrations of COIs in groundwater are unlikely to result in unacceptable concentrations of COIs in the Willamette River.

5.2 Ecological Risk Assessment Results

Hart Crowser (2002b; 2002c) conducted a Level 1 Scoping and a Modified Level 2 Screening ecological risk assessment (ERA) for the T1S facility. The purpose of the Level 1 Scoping ERA was to provide a conservative, qualitative determination of whether ecological receptors and/or exposure pathways are potentially present at or in the locality of the site. The Modified Level 2 Screening ERA was conducted using available groundwater data to determine whether constituents were present at levels of potential concern for aquatic ecological receptors in the adjacent Willamette River.

The Level 1 Scoping ERA did not identify any ecologically important upland species or habitats at the T1S facility. The site is currently almost entirely paved or covered by buildings. Future development (e.g., buildings, roads, landscaping) is also anticipated to almost entirely cover the T1S facility. The absence of upland habitat indicates that there are no current or likely future complete exposure pathways for terrestrial ecological receptors to come in contact with contaminated soil at the T1S facility. Site soils are currently covered (i.e., buildings, pavement) and anticipated to be covered in the future, therefore a complete soil erosion to surface water pathway was not identified.

A Modified Level 2 Screening ERA was conducted on the available groundwater monitoring well data collected at this site. There were no detected concentrations of organic constituents in the seven (7) groundwater monitoring wells that exceeded their corresponding Ecological Screening Benchmark Values (SBVs) or chronic freshwater AWQC. PAHs were present at low concentrations (less than 1.1 (µg/L) in five of the seven monitoring wells (Table 4 of the Groundwater Sampling Report). The detected PAHs, all non-carcinogenic, were present at concentrations below EBSLs.

Total (unfiltered) arsenic and chromium were detected in groundwater at concentrations below EBSLs at all well locations. Lead at MW-7 was detected at concentrations (maximum 4.47 µg/L) that exceeded the EBSL (2.5 µg/L) in both sampling rounds and copper exceeded (40.2 µg/L) the EBSL (9 µg/L) in one well in the first sampling round, the EBSL was not exceeded in the second round of sampling. Analysis of dissolved (filtered) arsenic, copper, chromium, and lead was conducted at all well locations. Dissolved concentrations did not exceed applicable EBSLs in any well. Based on this screening, it was concluded that there is no potential for adverse ecological impacts to aquatic ecological receptors from the discharge of groundwater to the Willamette River. No additional ecological risk assessment activities are warranted at this site.

6.0 IDENTIFICATION OF HOT SPOTS OF CONTAMINATION

A hot spot determination was completed for the facility. No groundwater hot spot was identified; however, hot spots are present for media other than groundwater or surface water. Hazardous substances (PAHs, lead, and arsenic) are present in soil at the T1S facility. With the exception of two samples, individual carcinogenic risk estimates are less than 100 times the acceptable risk level (1×10^{-6}) and noncarcinogenic risk estimates are less than 10 times the acceptable risk level (HQ of 1). Inspection of field logs did not identify indicators of free-phase petroleum hydrocarbons. Samples B-68 and B-92 had benzo(a)pyrene concentrations (7.05 mg/kg and 2.35 mg/kg, respectively) greater than the concentration corresponding to a hot spot risk level of 1×10^{-4} (2.1 mg/kg). Sample B-68 also had a lead concentration (6,190 mg/kg) greater than the Hot Spot Level (4,000 mg/kg). The B-68 and B-92 samples were collected from Area A and Area B, respectively. Identified soil hot spots and the extent of soil above risk-based concentrations is shown on Figure 6.

7.0 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) for this site are expressed as narrative goals and/or numerical cleanup levels for specific contaminants in groundwater and soil. RAOs are derived from the conceptual goals in Oregon's Environmental Cleanup Rules (OAR 340-122-040). This rule requires that remedial actions "address hazardous substances in a manner that assures protection of present and future public health, safety, and welfare, and the environment."

The risk assessment identified unacceptable risk to residents and commercial workers (Areas A and B) and to excavation and construction workers (Area A). The unacceptable risk results from direct contact with soil. The chemicals resulting in unacceptable risk for one or more pathways include PAHs, arsenic, and lead.

The preliminary RAOs for T1S facility are:

- Prevent residential or commercial worker exposure to near-surface (0 to 3 feet bgs) contamination (via ingestion, dermal contact, or particulate inhalation) that poses a hazard index greater than 1 or a lifetime excess cancer risk greater than 1×10^{-6} for individual carcinogens and 1×10^{-5} for multiple carcinogens.

- Prevent construction worker or trench worker exposure to subsurface (0 to 15 feet bgs) soil contamination (via ingestion, dermal contact, or particulate inhalation) that poses a hazard index greater than 1 or a lifetime excess cancer risk greater than 1×10^{-6} for individual carcinogens and 1×10^{-5} for multiple carcinogens.

- Prevent the excavation and redistribution of subsurface soil with concentrations above levels protective of future residents.

7.1 <u>Soil</u>

The cleanup levels for near surface soil (0 to 3 feet bgs) for the protection of future residents are:

• Lead	400 mg/kg
• Arsenic	5.3 mg/kg[1]
• Benzo(a)anthracene	0.21 mg/kg
• Benzo(a)pyrene	0.021 mg/kg
• Benzo(b)flouranthene	0.21 mg/kg
• Dibenzo(a,h)anthracene	0.021 mg/kg
• Indeno(1,2,3-cd)pyrene	0.21 mg/kg
• TPH	750 mg/kg[2]

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[1] DEQ recognizes that background arsenic concentrations at the site exceed EPA's PRG of 0.39 mg/kg for a residential scenario. The preliminary cleanup level is based on the site-specific background concentration calculated for the T1S Facility.

Cleanup levels for subsurface soil (3 to 15 feet bgs) are based on the protection of current and future construction workers (Hart Crowser, 2002c). The cleanup levels for surface and subsurface soil are also protective of future trench workers. The proposed cleanup levels for subsurface soil (3 to 15 feet bgs) are:

- Lead 750 mg/kg
- Arsenic 13 mg/kg
- Benzo(a)anthracene 21 mg/kg
- Benzo(a)pyrene 2.1 mg/kg
- Benzo(b)flouranthene 21 mg/kg
- Dibenzo(a,h)anthracene 2.1 mg/kg
- Indeno(1,2,3-cd)pyrene 21 mg/kg

The cleanup levels are considered protective of human health and to meet DEQ's definition of acceptable risk for individual and cumulative risk for multiple contaminants.

7.2 Groundwater

DEQ recognizes that shallow groundwater within the locality of the facility is not currently used and is not reasonably likely to be used in the future as a drinking water source. The current and reasonably like future use of groundwater at the site is surface water recharge. Available data and the results of the HHRA and ERA do not indicate groundwater poses a current unacceptable risk to human health or the environment and therefore, no further action is recommended.

8.0 DESCRIPTION AND EVALUATION OF REMEDIAL ACTION ALTERNATIVES

8.1 Areas and Volume of Contamination

Figure 3 shows the soil sample locations that exceed at least one of the cleanup criteria listed in Section 7.1. Figure 5 identifies the sample location, depth range, receptor, and contaminant type for the unacceptable samples. Figure 6 presents the generalized locations of soil hot spots and soil above the cleanup levels addressed in the FS. As discussed in Section 5.1.3, Area C was not included in the FS.

8.2 Remedial Action Alternatives

In the Feasibility Study (Hart Crowser, 2000b), potentially applicable clean-up technologies were identified and screened based on the ability to address the RAOs. Several of the technologies retained for further consideration were combined to develop remedial action alternatives that could

[2] The TPH cleanup goal is based on the selected cleanup level for the nearby Hoyt Street Station.

meet the RAOs and preliminary cleanup goals described in Section 7.0 for the T1S facility. These alternatives and screened in accordance with DEQ guidance. The alternatives are described below:

Alternative 1 – No Action: Alternative 1 serves as a baseline condition for comparison to other potential remedial alternatives.

Alternative 2 – Cover/Deed Restrictions with Hot Spot Removal: On-site soil above Hot Spot Levels (B-68 and B-92) would be excavated, loaded in trucks, and hauled to a licensed Subtitle C (hazardous waste) or D (solid waste) landfill. Approximately 80 cubic yards in the vicinity of B-68 (elevated metal concentrations) would be excavated separately from soil in the vicinity of B-92 and sampled to determine if the soil is a characteristic hazardous waste (based on leachability of lead). If the soil is designated a hazardous waste, this soil would be treated and disposed of at a licensed Subtitle C facility. Soil excavated in the vicinity of B-92 (approximately 260 cubic yards impacted primarily by PAH contamination) would be disposed of at a licensed Subtitle D disposal facility or treated at a licensed thermal treatment facility.

Clean, imported soil would be placed or uncontaminated overburden replaced at the site to restore the ground surface to the previously existing grade. In addition to the hot spot removals and disposal, 51,200 square feet of impacted surface soil would be permanently capped. A deed restriction would be implemented to notify owners or potential owners of the presence of the cap and associated restrictions. These restrictions would include appropriate training and protection requirements for future excavation or construction workers exposed to soil beneath the cap. Also, a soil management plan would be prepared to assure that any soil excavated deeper than 3 feet bgs that may pose unacceptable risk to residents if placed at the surface is appropriately managed. Site monitoring wells would be maintained to the extent practicable for potential future monitoring.

Alternative 3 – Off-Site Landfill Disposal: All soil above cleanup levels would be excavated for off-site disposal. Except for soil in the vicinity of B-38 and B-68, all soil would be disposed of in a Subtitle D solid waste landfill. This removal volume is estimated to be approximately 5,730 cubic yards. This quantity includes the hot spot soil at B-92. The soil in the vicinity of B-38 and B-68 (elevated metal concentrations) would be excavated separately and sampled to determine if the soil is a characteristic hazardous waste (based on leachability of lead). If designated a hazardous waste, this soil (about 340 cubic yards) would be loaded in trucks and hauled to a Subtitle C hazardous waste landfill for treatment and disposal. If the soil is determined to be nonhazardous, the soil would be disposed of with the remaining site soil.

Clean, imported soil would be placed or uncontaminated overburden replaced at the site to restore the ground surface to previously existing grade. Dust control would be achieved at the site by spray application of clean water to the ground surface as needed during removal activities There would be no long-term maintenance requirements with this alternative. Monitoring wells would be maintained to the extent practicable for potential future monitoring. Institutional controls would be implemented to assure proper management of any excavated contaminated soil.

Alternative 4 – Soil Treatment by Thermal Desorption/Selective Off-Site Landfill Disposal: All soil above cleanup levels would be excavated for off-site disposal or treatment. Except for soil in the vicinity of B-38 and B-68 all soil would be treated at a permitted thermal desorption facility. The removal volume for treatment in a thermal desorption unit is estimated to be approximately 5,730 cubic yards (including the hot spot soil at B-92). The soil in the vicinity of B-38 and B-68 (elevated metal concentrations exceeding waste acceptance criteria for a typical thermal desorption facility) would be excavated separately and sampled to determine if the soil is a characteristic hazardous waste (based on leachability of lead). If designated a hazardous waste, this soil (about 340 cubic yards) would be loaded in trucks and hauled to a Subtitle C hazardous waste landfill for treatment and disposal. If the soil is determined to be nonhazardous, the soil would be disposed of in a Subtitle D solid waste landfill.

Clean, imported soil would be placed or uncontaminated overburden replaced at the site to restore the ground surface to previously existing grade. Dust control would be achieved at the site by spray application of clean water to the ground surface as needed during removal activities. There would be no long-term maintenance requirements for this alternative. Site monitoring wells would be maintained to the extent practicable for potential future monitoring. Institutional controls would be included implemented to assure proper management of any excavated contaminated soil.

8.3 Remedial Action Alternative Evaluation

All four alternatives were evaluated against the protectiveness requirement and balancing of remedy selection factors (i.e., effectiveness, long-term reliability, implementability, implementation risk, and reasonableness of cost). A comparative analysis of the four alternatives is presented in the FS report (Hart Crowser, 2002c) and is summarized in Table 3. The FS also evaluated how well the alternatives met DEQ's preference for treatment of identified hot spots.

8.3.1 Protectiveness

An alternative must be protective as defined by OAR 340-122-0040 to be acceptable. With the exception of the No Action Alternative (Alternative 1) all of the remedial actions meet the protectiveness criterion.

The removal of lead and PAH contaminated soil above selected cleanup levels in Alternatives 3 and 4 results in acceptable risk for individual compounds with the exception of arsenic. The HHRA indicates that the human health risk associated with arsenic is above the acceptable risk range for all alternatives. This risk is, however, associated with arsenic at concentrations that are below the site-specific background concentration in surface soil and below levels considered protective of excavation workers and construction workers in soil from 0 to 15 feet bgs. Alternatives 2, 3, and 4 also rely on the use institutional controls to eliminate exposure future pathways to soil.

8.3.2 Effectiveness and Long-Term Reliability

The alternatives were ranked based on the permanency of the alternative and the time required to complete the remedial action. The Landfill (Alternative 3) and Thermal Treatment (Alternative 4) alternatives are essentially permanent and require the same length of time (equally ranked). The Cover Alternative (Alternative 2) ranked next, with No Action (Alternative 1) last.

As for long-term reliability, alternatives that permanently treat the contamination ranked highest. The Thermal Treatment Alternative (Alternative 4) was ranked higher than the Landfill Alternative (Alternative 3) because a substantial portion of the removal volume would be treated by thermal desorption (permanently destroying the contaminants). The Cover Alternative (Alternative 2) is ranked the second lowest because only a small portion of the contaminant volume (i.e., hot spot volume) is removed from the site. The No Action Alternative (Alternative 1) was not considered a reliable remedial alternative.

8.3.3 Implementability and Implementation Risk

The No Action Alternative (Alternative 1) was considered the most easily implemented remedial action. The soil removal alternatives were considered to be equally implementable because they use similar construction methods.

The No Action Alternative carries no implementation risk. Because implementation risk is primarily a function of excavation quantities and transport of contamination on roadways, alternatives with less excavation (Cover) ranked higher and alternatives with shorter haul distances (Thermal Treatment) ranked next. Therefore, the Landfill Alternative ranked last.

8.3.4 Reasonableness of Cost

Cost estimates were developed for each of the remedial options based on capital and long-term costs. The following list summarizes the present worth total cost estimates for each alternative.

- No Action ($0);
- Cover ($288,000);
- Landfill ($559,000); and
- Thermal Treatment ($564,000).

The cover alternative (Alternative 2) is considered the least-cost protective remedy that addresses the protection of human health under both existing and future conditions and meets DEQ's preference for treatment of hotspots.

Alternatives 3 and 4 provide a significant reduction in the residual site risk though removal of near surface (0-3 feet bgs) contaminated soil above residential cleanup levels and removal of subsurface (3-15 feet bgs) contaminated soil above cleanup levels protective of trench workers and construction workers. The incremental cost difference between Alternatives 2 and 3 is approximately $271,000. Based on the removal of contamination above cleanup levels, Alternatives 3 and 4 do not require a cap to prevent exposure to soil contamination remaining on-site and hence does not require long-term maintenance. Therefore, the institutional controls required for the site would be less.

8.3.5 Preference for Treatment of Hot Spots

Alternatives 2, 3, and 4 include removal of soil hot spots and therefore meet DEQ's preference for treatment as defined by OARs.

9.0 PEER REVIEW SUMMARY

A project team consisting of a project manager (a State of Oregon registered geologist), remedial engineer (a State of Oregon profession engineer) and a toxicologist have been involved throughout this project. Team members have reviewed project documents such as draft and final characterization, risk assessment, and feasibility study reports and DEQ's Staff Report of the Recommended Remedial Action. The project team supports the selected remedial action described in Section 10.0.

10.0 SELECTED REMEDIAL ACTION

10.1 <u>Description of Selected Remedial Action</u>

The selected action for the Parcels A and B of the T1S facility is Alternative 3 as modified by DEQ. The selected remedy consists of the following elements:

- Removal of contaminated soil above risk-based soil cleanup levels:
  - Soil above clean up levels protective of future site residents between 0 and 3 feet bgs will be removed.
  - Soil above levels protective of construction workers and trench workers between 3 and 15 feet bgs will be removed.
  - Excavated soil will either be disposed of at an off-site DEQ permitted landfill or treated using thermal desorption and treated soil placed back on-site or disposed of at a DEQ approved location.
- Institutional controls including a deed restriction (e.g., a DEQ-approved Easement and Equitable Servitude) to assure that future land use remains consistent with the selected remedy and that a soil management plan is followed to prevent exposure to soil contamination remaining on-site following the removal of soil hot spots and soil above risk-based criteria.

DEQ modifications to Alternative 3 are as follows:

- Allow for excavated contaminated soil to be disposed of at either a licensed landfill or to be treated using thermal desorption. The Port may select the disposal method based on competitive bids or a more detailed cost evaluation. The Port will notify DEQ in writing of the selected method.

- Thermally treated soil can be backfilled on-site if it is demonstrated that the treated soil meets the appropriate cleanup levels. DEQ considers soil disposal or treatment as equally protective and effective in reducing future site risks. If treated soil are placed on-site the Port will also document that the location and depth that the soil are placed.

- In order to assure long-term protection of human health and the environment, institutional controls are required. The institutional controls will consist of a deed restriction that:
  - Requires notification of future landowners of the presence of soil contamination remaining following the removal activities;
  - Requires that soil excavated in the future below 3 feet bgs be managed in accordance with the selected remedy. Soil placed within 3 feet of the land surface must meet residential cleanup levels; and
  - Assures that future land use of the property is consistent with assumptions in the baseline and residual risk assessments (e.g., mixed residential and commercial land use with no significant habitat).

- Requires DEQ review and approval of a Soil Management Plan that will prescribe appropriate methods to characterize, manage, and dispose of contaminated soil in the event excavation is performed in the future at depths greater than 3 feet bgs or in the event unexpected conditions are encountered during site development.

Alternatives 3 and 4 are comparable with respect to their effectiveness, long-term reliability, and implementability. The modified Alternative 3 is selected to assure protection of human health and the environment under both existing and future conditions.

10.2 Satisfaction of Protection and Feasibility Requirements

The selected remedial action meets the requirements of ORS 465.315 and OAR 340-122-040 and –115.

10.2.1 Protectiveness

The selected remedy is considered protective of human health and the environment. The acceptable risk level prescribed by Oregon statute and rule for human health is a 1×10^{-6} excess cancer risk for individual carcinogens, 1×10^{-5} excess cancer risk for multiple carcinogens and a hazard index of 1 or less for noncarcinogens. The selected remedy in general meets the protectiveness criteria with the exception of potential risks associated with arsenic. The selected remedy results in a reduction of the baseline risk associated with lead and PAHs. Baseline risks for arsenic are not anticipated to be reduced due to background arsenic concentrations. Institutional controls are required to prevent exposure to contaminated soil and to assure that future land use and risk assessment assumptions remain consistent with the selected remedy.

10.2.2 Effectiveness and Long-term Reliability

The selected remedy is considered effective and permanent for the removal of soil contaminated above hot spot levels, established cleanup levels, and the regional background level for arsenic. Institutional controls provide long-term reliability since they would prohibit groundwater use and would require the development of a soil management plan to prevent contaminated soil remaining on-site following the removal action to be redistributed on-site at concentrations that would result in an unacceptable risk to human health or the environment.

10.2.3 Implementability and Implementation Risk

The selected remedy is readily implementable. Contractors to perform the soil removal are readily available within Portland.

10.2.4 Reasonableness of Cost

While the FS identified the capping alternative (Alternative 2) as the least-cost protective remedy, the additional cost of the selected Alternative is justified by further consideration of the following balancing factors in OAR 340-122-090(3):

- Effectiveness. The selected alternative is considered more effective in achieving RAOs since it provides a significant permanent reduction in the site risk though removal of hot spots and removal of contaminated soil above selected cleanup levels.

- Long-term reliability. The removal of soil above selected clean-up levels results in a permanent reduction in site risk; therefore the selected remedy is considered more reliable. In addition, the uncertainties of long-term management (e.g., operation, maintenance, and monitoring) and enforceability over time of engineering and institutional controls in managing site risks are significantly reduced. Based on the removal of contamination above selected cleanup levels, a cap is not required to prevent exposure to soil contamination remaining on-site, long-term monitoring and maintenance is not required, and limited institutional controls are required.

Based on consideration of the increased effectiveness and long-term reliability, the selected remedy is considered cost reasonable. As mentioned in Section 10.1, if the implementation risk criterion is not considered, the Landfill (Alternative 3) and Thermal Treatment Alternative (Alternative 4) are equally protective and effective. Therefore, in this case, the Port will select lower cost soil disposal or treatment alternative at the time of removal.

11.0 PUBLIC NOTICE AND COMMENTS

DEQ's notice of the proposed remedial action was published in the Oregon Secretary of State's Bulletin and The Oregonian on July 1, 2002. Copies of the site investigation report, risk assessment, and feasibility study and other pertinent project documents were made available for public review at DEQ's Northwest Regional Office in Portland, Oregon.

A public comment period began July 15 and ended on August 15, 2002. No comments were received regarding the proposed remedial action in response to DEQ's public notice.

12.0 CONSIDERATION OF PUBLIC COMMENTS

As noted in Section 11, no comments were received and therefore no changes were made to the proposed remedy.

13.0 FINAL DECISION OF THE DIRECTOR

The selected remedial action for the Oregon Brass Works site is protective, cost reasonable, effective, and implementable. The selected remedy therefore satisfies the requirements of ORS 456.315 and OAR 340-122-040 through –115. The detailed evaluation of how the selected remedy meets the regulatory requirements is provided in Sections 8.2 and 10.2.

14.0 SIGNATURE

Neil Mullane — 9/26/02

Neil Mullane
Northwest Region Administrator

Date

ATTACHMENT A

The following documents were reviewed by DEQ and comprise the administrative record for this site:

DEQ, 1998. Guidance for Ecological Risk Assessment: Level I Scoping, Final. Dated November 1998.

DEQ, 1998. Guidance for Conduct of Deterministic Human Health Risk Assessments. Final. Dated December 1998; updated May 2000.

DEQ, 2001a. DEQ Document Review – Port of Portland Marine Terminal South, Portland, Oregon – ECSI 2642. Letter prepared for Port of Portland by DEQ approving "*Remedial Investigations*" report. Dated July 26, 2001.

DEQ, 2002a. DEQ Document Review – Port of Portland Marine Terminal South, Portland, Oregon – ECSI 2642. Letter prepared for Port of Portland by DEQ approving the "*Human Health and Ecological Baseline Risk Assessment Report and Addendum*" report. Dated July 12, 2002.

DEQ, 2002b. DEQ Document Review – Port of Portland Marine Terminal South, Portland, Oregon – ECSI 2642. Letter prepared for Port of Portland by DEQ approving the "*Feasibility Study*" report. Dated July 12, 2002.

Hahn and Associates (2001a). Terminal 1 South Remedial Investigations Report (Volumes 1 & 2). Prepared for The Port of Portland. Dated July 12, 2001.

Hahn and Associates (2001b). Monitoring Well Installation and Groundwater Sampling Report. Prepared for The Port of Portland. Dated December 19, 2001.

Hahn and Associates (2002). Groundwater Sampling Report. Dated February 25, 2002.

Hart Crowser (2002a). Terminal 1 South Human Health and Ecological Baseline Risk Assessment – Portland, Oregon. Prepared for The Port of Portland. Dated January 18, 2002.

Hart Crowser (2002b). Terminal 1 South Human Health and Ecological Baseline Risk Assessment Addendum – Portland, Oregon. Prepared for The Port of Portland. Dated June 2002.

Hart Crowser (2002c). Terminal 1 South Feasibility Study – Portland, Oregon. Prepared for The Port of Portland, Oregon. Dated June 2002.

Hart Crowser (2002d). Terminal 1 South Removal Work Plan – Portland, Oregon. Prepared for The Port of Portland, Oregon. Dated June 2002. Addresses removal of contaminated soil in Parcels A and B.

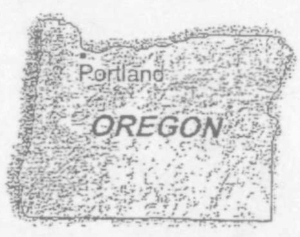
Maul Foster & Alongi, Inc, (1998). Focused Environmental Site Assessment, Terminal 1, Between Slip No. 2 and the Freemont Bridge, Northwest Portland, Oregon. Dated August 25, 1998.

RETEC (1997). Groundwater Beneficial Use Assessment for the Hoyt Street Railyard and Surrounding Area, Portland, Oregon. Dated March 27, 1997.

Site Location Map
Terminal 1 South . asibility Study
Port of Portland, Portland, Oregon

F:\DATA\Jobs\Port of Portland\15230 Term 1 Support\FS\Figures\1523000 01 (Site Loc)-fs

Note: Base map prepared from the USGS 7.5-minute quadrangle of Portland, OR dated 1990.

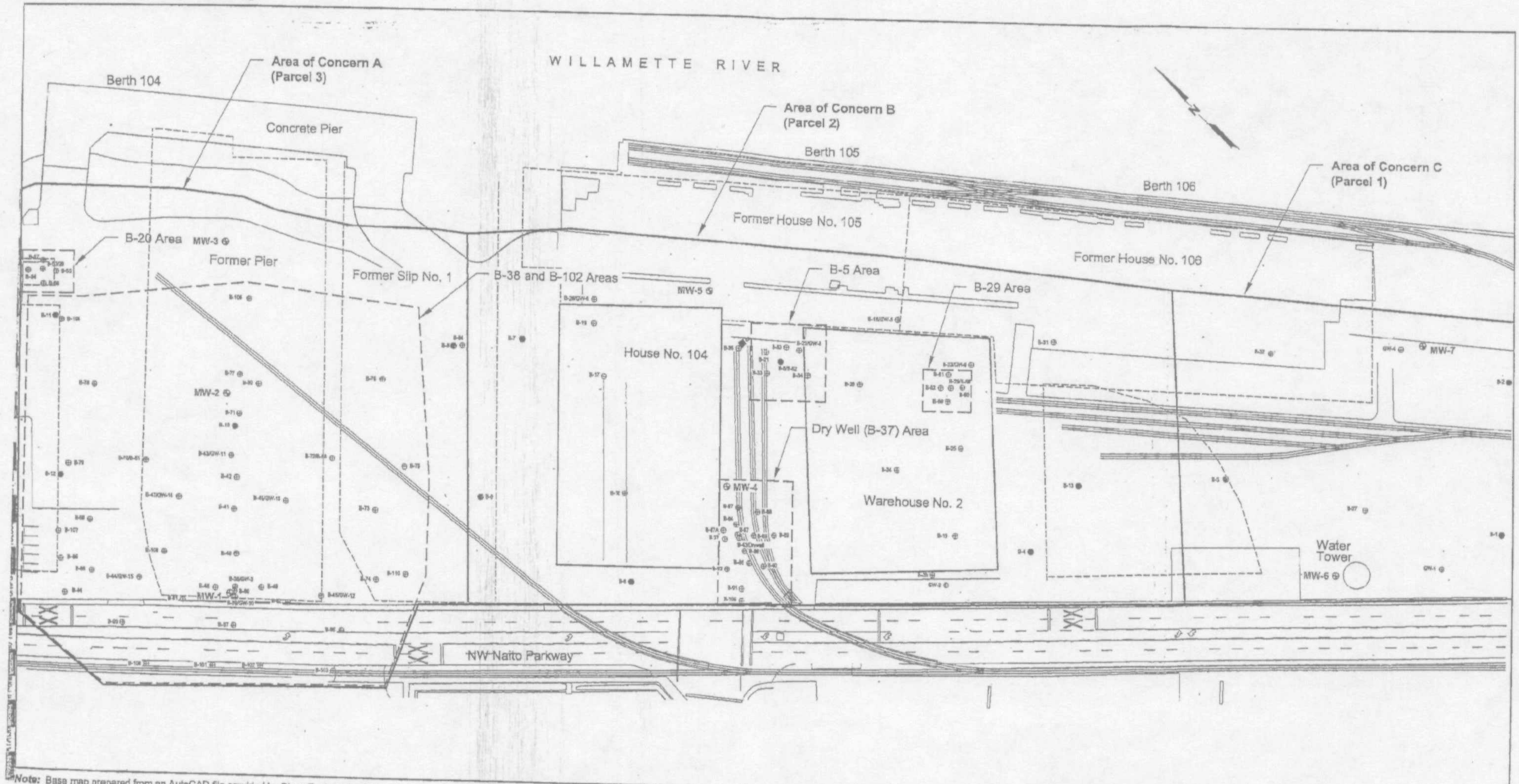


0 2,000 4,000

Scale in Feet
Contour Interval 10 Feet

HARTCROWSER
15230 *6/02*
Figure 1

Site Plan
Terminal 1 South Feasibility Study
Port of Portland, Portland, Oregon



Note: Base map prepared from an AutoCAD file provided by Olson Engineering, 8/27/01.

Legend:

Maul Foster and Alongi, Inc. Push Probe Boring Location and Number (March 1998)

HAI Push Probe Boring Location and Number (2000)

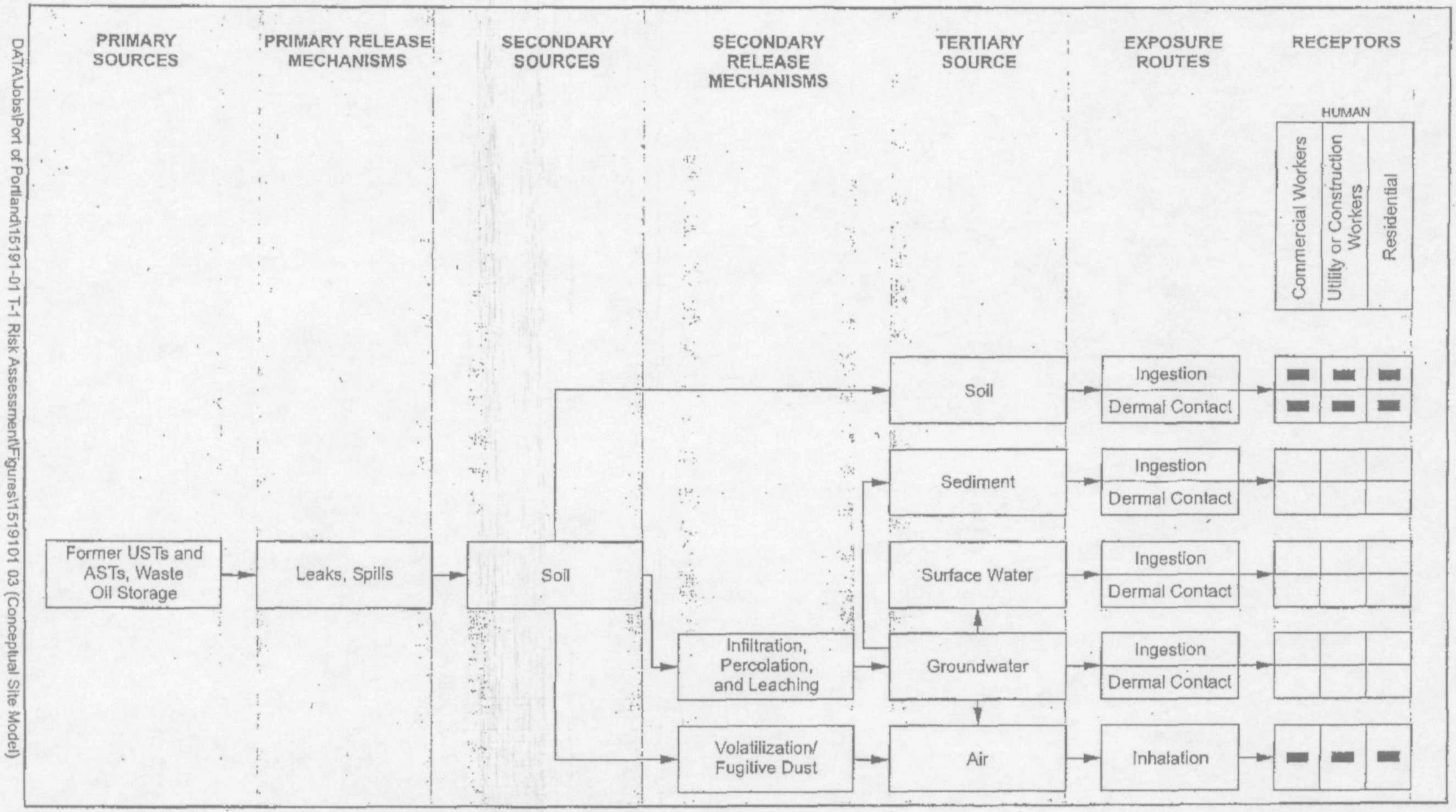
MW-1 HAI Monitoring Well Location and Number (2001)

0 100 200
Approximate Scale in Feet

HARTCROWSER
15230 6/02
Figure 2

POPT1S600815

Human Health Conceptual Site Model
Terminal 1 South Risk Assessment
Port of Portland, Portland, Oregon



Legend:

▬ Potentially Complete Pathway

DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Figures\1519101 03 (Conceptual Site Model)

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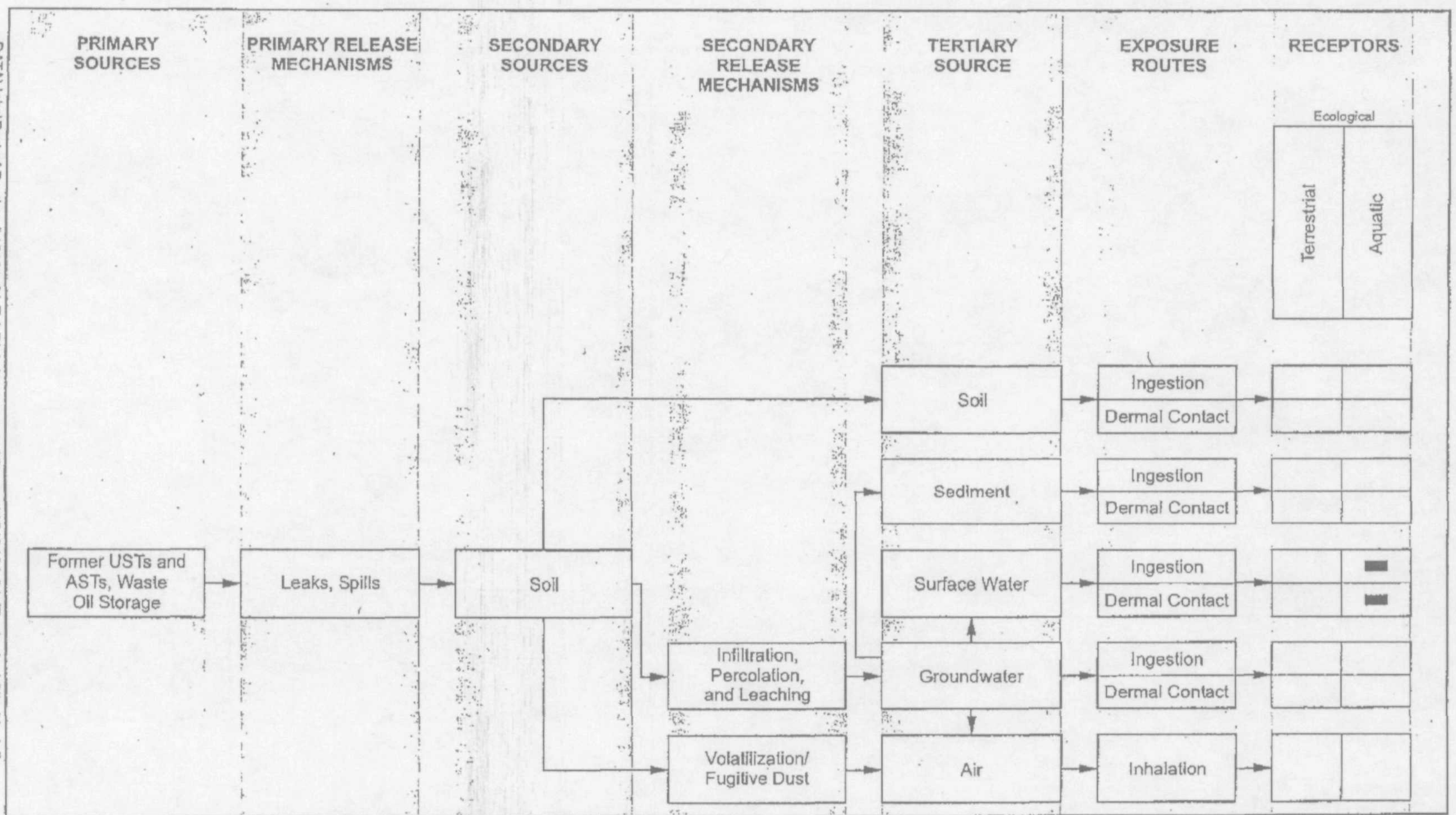
15191-01 1/02
Figure 3

POPT1S600816

Ecological Conceptual Site Model
Terminal 1 South Risk Assessment
Port of Portland, Portland, Oregon



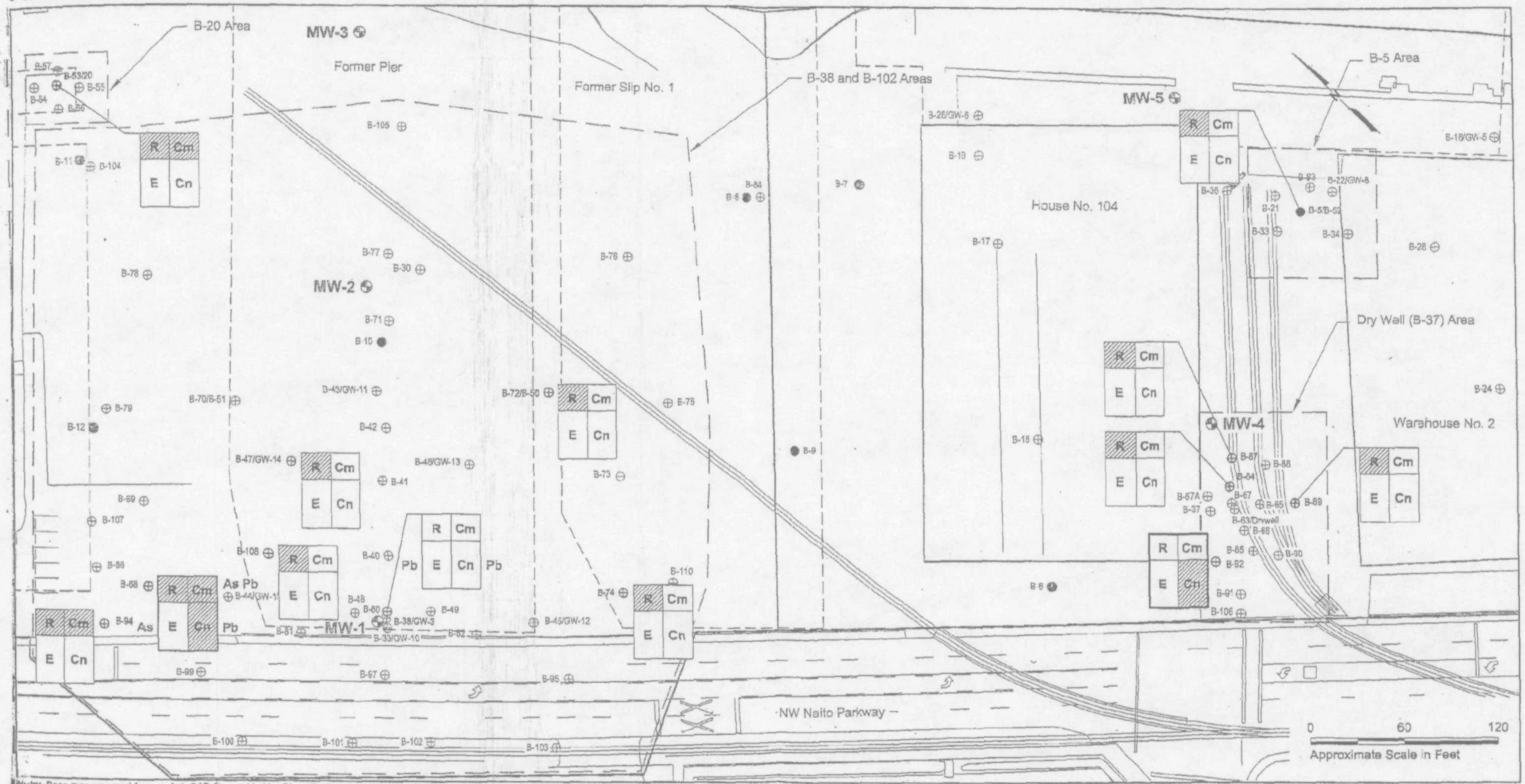
DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Figures\1519101 04 (Ecological Site Model)

Legend:

▬ Potentially Complete Pathway

HARTCROWSER
15191-01 1/02
Figure 4

Soil Samples Exceeding Cleanup Levels
Terminal 1 South Feasibility Study
Port of Portland, Portland, Oregon



Note: Base map prepared from an AutoCAD file provided by Olson Engineering, 8/27/01.

Legend:

- Maul Foster and Alongi, Inc. Push Probe Boring Location and Number (March 1998)
- HAI Push Probe Boring Location and Number (2000)
- MW-1 HAI Monitoring Well Location and Number (2001)

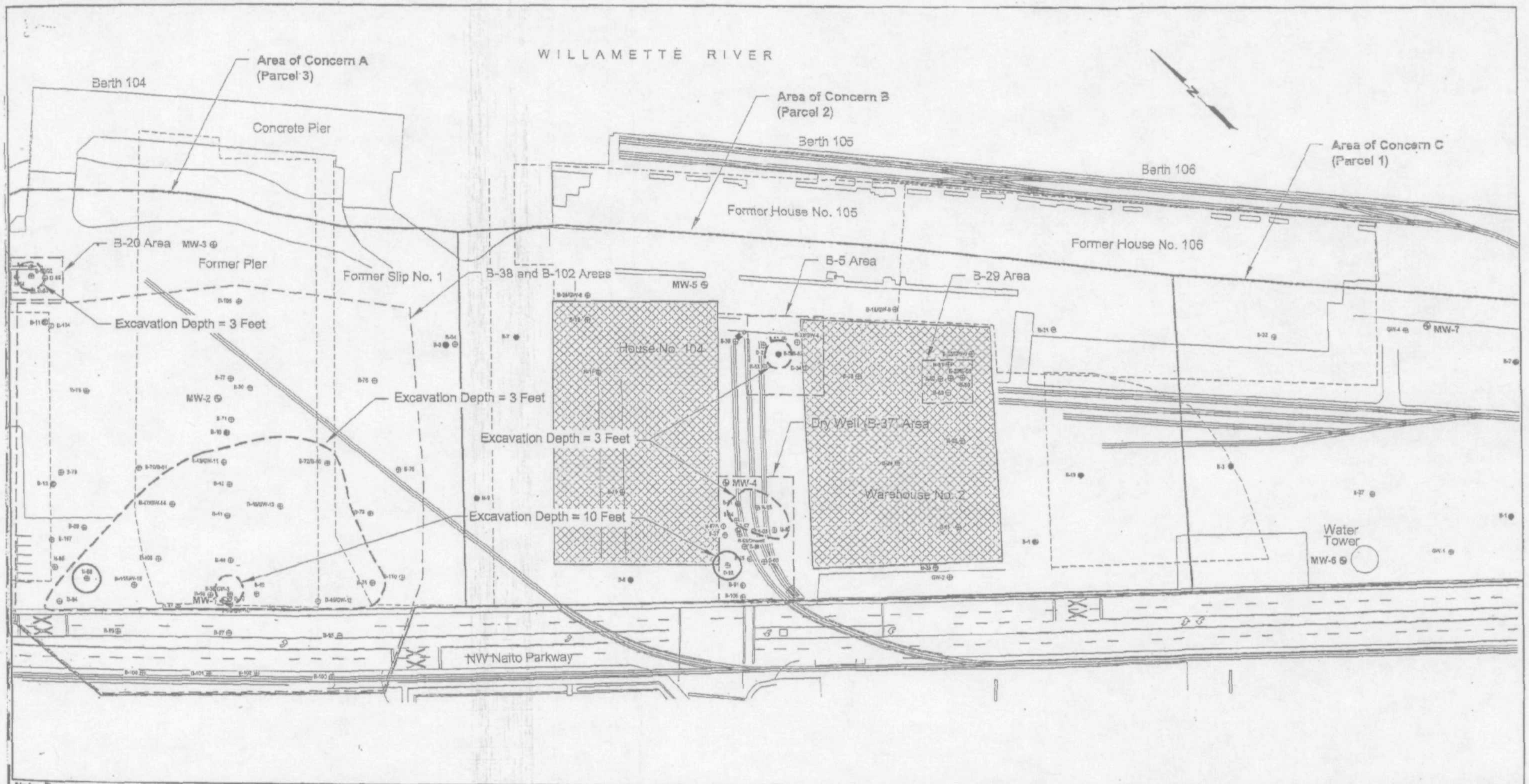
R	Cm
E	Cn

R = Residential (0-3 Ft.), Cm = Commercial (0-3 Ft.)
E = Excavation/Utility Worker (0-15 Ft.)
Cn = Construction Worker (0-15 Ft.)

PAHs Above Cleanup Level for Corresponding Exploration
Metals Above Cleanup Level for Corresponding Exposure
As Arsenic
Pb Lead
Hot Spot

HARTCROWSER
15230 6/02
Figure 5

Location of Soil Above Cleanup or Hot Spot Levels
Terminal 1 South Feasibility Study
Port of Portland, Portland, Oregon



Note: Base map prepared from an AutoCAD file provided by Olson Engineering, 8/27/01.

Legend:

- B-4 ⊕ Maul Foster and Alongi, Inc. Push Probe Boring Location and Number (March 1998)
- B-40 ⊕ HAI Push Probe Boring Location and Number (2000)
- MW-1 ⊕ HAI Monitoring Well Location and Number (2001)
- — — — Soil Above Remedial Action Levels
- ——— Soil Exceeding Hot Spot Level

0 100 200
Approximate Scale in Feet

HARTCROWSER
15230 6/02
Figure 6

POPT1S600819

Table 1 - Risk and Hazard Summary: By Exposure Pathway
Marine Terminal 1 South Risk Assessment
Portland, Oregon

SubArea	Exposure Scenario	RME Cancer Risk					RME Hazard Index				
		Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL	Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL
Area A	Resident	8.E-05	8.E-05	4.E-09	3.E-08	2.E-04	7.E-01	3.E-01	8.E-05	0.E+00	**1.E+00**
	Commercial Worker	1.E-05	3.E-06	5.E-10	5.E-09	**1.E-05**	3.E-02	3.E-03	5.E-06	0.E+00	**3.E-02**
	Excavation Worker	5.E-08	3.E-08	9.E-14	5.E-12	**8.E-08**	3.E-03	9.E-04	3.E-08	0.E+00	**4.E-03**
	Construction Worker	6.E-07	1.E-07	3.E-12	2.E-10	**7.E-07**	6.E-02	6.E-03	1.E-06	0.E+00	**7.E-02**
Area B	Resident	2.E-05	1.E-05	3.E-08	9.E-09	3.E-05	3.E-01	1.E-01	2.E-02	0.E+00	**4.E-01**
	Commercial Worker	2.E-06	4.E-07	1.E-10	2.E-09	**2.E-06**	1.E-02	1.E-03	1.E-06	0.E+00	**1.E-02**
	Excavation Worker	6.E-08	6.E-08	3.E-14	3.E-12	**1.E-07**	2.E-03	5.E-04	1.E-08	0.E+00	**3.E-03**
	Construction Worker	1.E-06	4.E-07	1.E-12	1.E-10	**1.E-06**	4.E-02	3.E-03	4.E-07	0.E+00	**4.E-02**
Area C	Resident	1.E-05	4.E-06	NA	8.E-09	1.E-05	2.E-01	9.E-02	NA	0.E+00	**3.E-01**
	Commercial Worker	2.E-06	1.E-07	NA	2.E-09	**2.E-06**	9.E-03	9.E-04	NA	0.E+00	**1.E-02**
	Excavation Worker	4.E-08	1.E-08	NA	1.E-11	**5.E-08**	7.E-03	2.E-03	NA	0.E+00	**9.E-03**
	Construction Worker	8.E-07	8.E-08	NA	4.E-10	**9.E-07**	1.E-01	1.E-02	NA	0.E+00	**1.E-01**

SubArea	Exposure Scenario	CT Cancer Risk					CT Hazard Index				
		Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL	Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL
Area A	Resident	7.E-07	8.E-07	7.E-10	2.E-09	**2.E-06**	8.E-03	3.E-03	3.E-05	0.E+00	**1.E-02**
	Commercial Worker	4.E-07	2.E-07	6.E-11	5.E-10	**6.E-07**	5.E-03	8.E-04	2.E-06	0.E+00	**6.E-03**
	Excavation Worker	2.E-09	1.E-09	2.E-14	2.E-12	**3.E-09**	4.E-04	1.E-04	1.E-08	0.E+00	**5.E-04**
	Construction Worker	6.E-08	4.E-08	6.E-13	4.E-11	**1.E-07**	1.E-02	3.E-03	4.E-07	0.E+00	**1.E-02**
Area B	Resident	3.E-07	2.E-07	4.E-09	2.E-09	**5.E-07**	7.E-03	3.E-03	6.E-03	0.E+00	**2.E-02**
	Commercial Worker	2.E-07	5.E-08	1.E-11	4.E-10	**3.E-07**	5.E-03	7.E-04	4.E-07	0.E+00	**6.E-03**
	Excavation Worker	2.E-09	2.E-09	5.E-15	1.E-12	**4.E-09**	3.E-04	1.E-04	4.E-09	0.E+00	**4.E-04**
	Construction Worker	7.E-08	5.E-08	2.E-13	4.E-11	**1.E-07**	9.E-03	3.E-03	1.E-07	0.E+00	**1.E-02**
Area C	Resident	3.E-07	1.E-07	NA	2.E-09	**4.E-07**	7.E-03	3.E-03	NA	0.E+00	**1.E-02**
	Commercial Worker	2.E-07	3.E-08	NA	4.E-10	**2.E-07**	5.E-03	7.E-04	NA	0.E+00	**6.E-03**
	Excavation Worker	2.E-09	6.E-10	NA	3.E-12	**3.E-09**	7.E-04	2.E-04	NA	0.E+00	**9.E-04**
	Construction Worker	6.E-08	2.E-08	NA	7.E-11	**8.E-08**	2.E-02	5.E-03	NA	0.E+00	**2.E-02**

F:\DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Tables\Table 10 and 11 Risk Sum

Note:
1. Shaded boxes indicate exposure scenaros that exceed DEQ's acceptable risk targets.

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Table 2 - RME Risk Summary: By COPC
Marine Terminal 1 South Risk Assessment
Portland, Oregon

SubArea	Exposure Scenario	COPC	RME Cancer Risk				
			Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL
Area A	Resident	Benzo(a)anthracene	4.E-06	6.E-06	na	1.E-10	1.E-05
		Benzo(a)pyrene	4.E-05	5.E-05	na	1.E-09	9.E-05
		Benzo(b)fluoranthene	3.E-06	4.E-06	na	8.E-11	7.E-06
		Dibenz(a,h)anthracene	3.E-06	5.E-06	na	1.E-10	8.E-06
		Indeno(1,2,3-cd)pyrene	1.E-06	2.E-06	na	4.E-11	4.E-06
		Arsenic	3.E-05	1.E-05	na	2.E-08	5.E-05
		Tetrachloroethene	na	na	4.E-09	na	4.E-09
		TOTAL	**8.E-05**	**8.E-05**	**4.E-09**	**3.E-08**	**2.E-04**
	Commercial Worker	Benzo(a)anthracene	5.E-07	2.E-07	na	3.E-11	7.E-07
		Benzo(a)pyrene	5.E-06	2.E-06	na	2.E-10	7.E-06
		Benzo(b)fluoranthene	4.E-07	2.E-07	na	2.E-11	5.E-07
		Dibenz(a,h)anthracene	4.E-07	2.E-07	na	2.E-11	6.E-07
		Indeno(1,2,3-cd)pyrene	2.E-07	8.E-08	na	9.E-12	3.E-07
		Arsenic	4.E-06	4.E-07	na	5.E-09	5.E-06
		Tetrachloroethene	na	na	6.E-10	na	6.E-10
		TOTAL	**1.E-05**	**3.E-06**	**6.E-10**	**5.E-09**	**1.E-05**
Area B	Resident	Benzo(a)anthracene	3.E-07	4.E-07	na	9.E-12	7.E-07
		Benzo(a)pyrene	4.E-06	5.E-06	na	1.E-10	9.E-06
		Benzo(b)fluoranthene	3.E-07	4.E-07	na	8.E-12	6.E-07
		Indeno(1,2,3-cd)pyrene	2.E-07	3.E-07	na	7.E-12	6.E-07
		Arsenic	1.E-05	4.E-06	na	9.E-09	2.E-05
		Chloroform	na	na	3.E-08	na	3.E-08
		TOTAL	**2.E-05**	**1.E-05**	**na**	**9.E-09**	**3.E-05**
	Commercial Worker	Benzo(a)anthracene	4.E-08	2.E-08	na	2.E-12	5.E-08
		Benzo(a)pyrene	5.E-07	2.E-07	na	2.E-11	7.E-07
		Benzo(b)fluoranthene	3.E-08	1.E-08	na	2.E-12	5.E-08
		Indeno(1,2,3-cd)pyrene	3.E-08	1.E-08	na	2.E-12	4.E-08
		Arsenic	2.E-06	2.E-07	na	2.E-09	2.E-06
		TOTAL	**2.E-06**	**4.E-07**	**na**	**2.E-09**	**3.E-06**
Area C	Resident	Arsenic	1.E-05	4.E-06	na	8.E-09	2.E-05
	Commercial Worker	Arsenic	2.E-06	2.E-07	na	2.E-09	2.E-06

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Note:
1. Shaded boxes indicate COPC that exceeds DEQ acceptable risk target.

Table 3

Comparison of Remedial Action Alternatives
Marine Terminal 1 South Feasibility Study
Portland, Oregon

Alternative	Effectiveness				Long-Term Reliability				Implementability				Implementation Risk				Cost				Score	Rank
Soil	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D		
A No Action		-	-	-		-	-	-		+	+	+		+	+	+		+	+	+	3	4
B Cover/Deed Restriction with Hot Spot Removal	+		-	-	+		-	-	-		-	-	-		+	+	-		+	+	-3	3
C Off-Site Landfill Disposal	+	+		0	+	+		-	-	+		0	-	-		-	-	-		+	-1	2
D Treatment by Thermal Desorption/Limited Off-site Landfill Disposal	+	+	0		+	+	+		-	+	0		-	-	+		-	-	-		1	1

F:\DATA\Jobs\Port of Portland\15230 Term 1 Support\Tech Supp and FS, -00\Feasibility Study (Table 2 and 4)

Notes:
1. + = The alternative is favored over the compared alternative (score=1)
2. 0 = The alternative is equal with the compared alternative (score=0)
3. - = The alternative is less favorable than the compared alternative (score=-1)
4. Rank based on both protectiveness and balancing factors.

Key to Comparison Grid

	Criteria			
Technology A		B	C	D
Technology B	A		C	D
Technology C	A	B		D
Technology D	A	B	C	